AMRAD Newsletter

AMATEUR RADIO RESEARCH AND DEVELOPMENT CORPORATION

P.O. Drawer 6148 *McLean, VA. USA 22106-6148* Vol. XVI - No.6

CALENDAR

Meetings are normally held on the first Monday of each month at the Red Cross Building in Merrifield Va.

Monday	Dec 4	Meeting
Monday	Jan 8	Meeting
Monday	Feb 5	Meeting
Monday	Mar 5	Meeting

AMRAD is publishing six Newsletter issues a year (on the first weekend of each odd numbered month). Authors are encouraged to submit copy to the editor by the first weekend of even months for the next Newsletter. The originals of figures, pictures, or graphics should be directed to the Publisher (Bill Pala) with a copy to the Editor (Deborah Borden).

President's Ramblings:

a Spread-Spectrum Repeater, a Phase-lock loop circuit from Great-Britain, and Some Idle Thoughts.

by Andr Kesteloot N4ICK.

During a recent visit to Chuck Phillips N4EZV's shack, I could not help but notice a new rack containing, among other things, a 900 MHz duplexer. It is part of his latest design, a repeater for direct-sequence spread spectrum transmissions. How does it work? Referring to the figure on the next page, the duplexer output feeds (1) a down-converter with an output centered at 70MHz. Then (2) the first IF stage splits the IF into two channels separated by the 1st IF output frequency. This is fed to (3) the 2nd IF stage which takes the output of the separated channels, combines (XOR) the two, filters and limits the output. The latter drives a PSK demodulator (in our case a Costas-loop) which converts the 2nd IF signal to a digital output. Module (5), the clock-recovery and CVSD demodulator extracts the clock from the digital signal and combines data and clock in CVSD to convert back to audio (baseband). This audio signal is filtered and amplified (AGC) to remove any high-frequency audio component.

The COR module (6) produces an output based on valid clock-and-data signals to turn on the transmitter.

Module (7) is the CVSD and PN generator. The filtered audio from module (5) is applied to the CVSD. A locally-generated clock drives the pseudo-random generator and, after division, also drives the CVSD. The CVSD output and the PN generator output are XORed and then applied to a PN modulator, while the PN generator output is delayed by 90 degrees and applied to a second PN modulator. The output of these two doubly-balanced mixers are then combined (summed) in (8). The resulting signal is then up-converted to the 900 MHz band in (9) and amplified in (10) the output power amplifier.

Several of the modules are in various stages of completion. (Some are based on well-established design, and the Costas loop, for instance, works like a charm.) Each major module is housed in a separate aluminum box, with BNC connectors and feed-through capacitors, to provide maximum isolation and facilitate maintenance. The duplexer and the antennas have already been tested, and the repeater has been given, I understand, tentative experimental coordination status by TMARC. Should you be interested in discussing this project with Chuck Phillips, you may call him at (301) 257-2108.

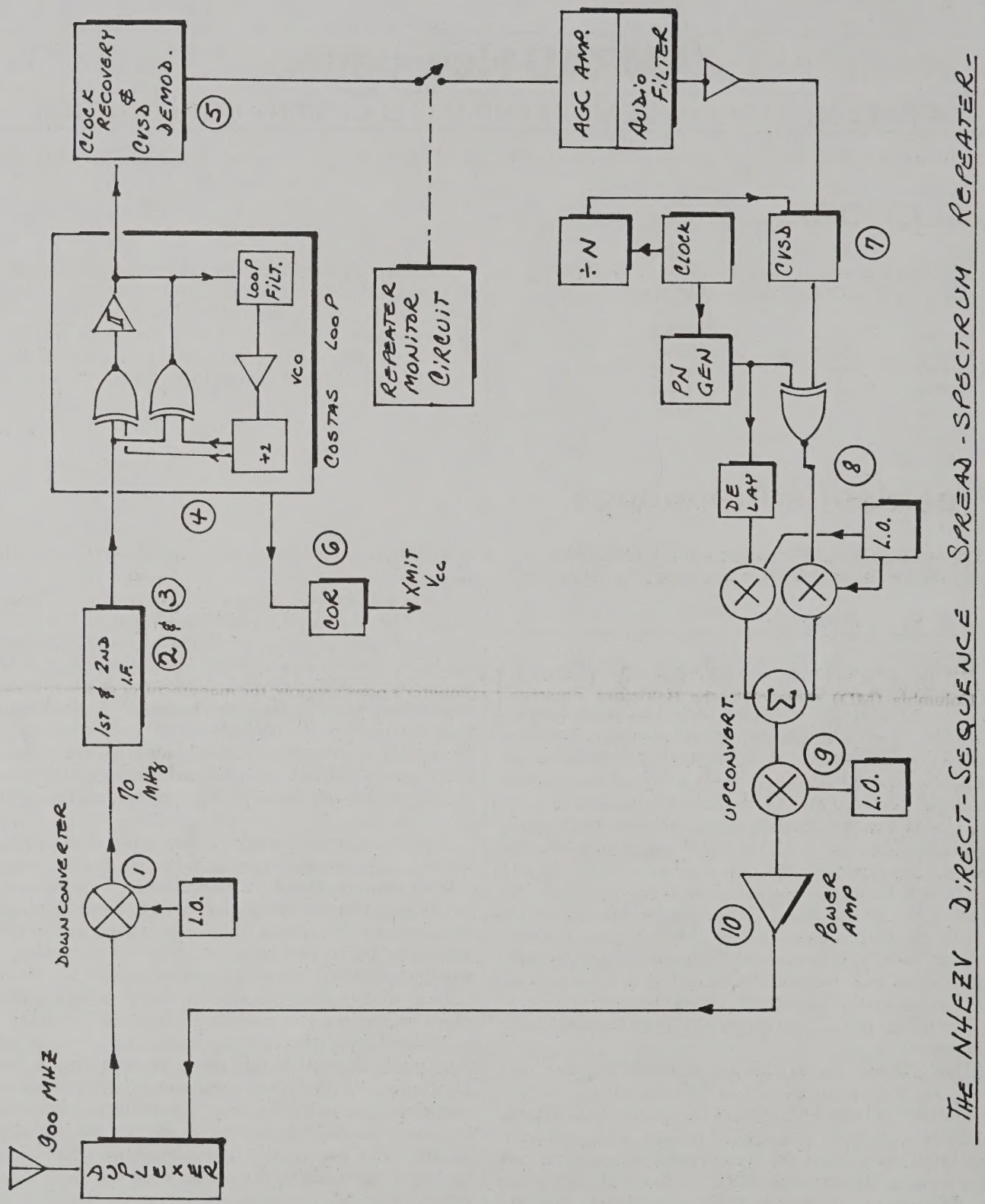
Elsewhere in this Newsletter you will find an article by another spread-spectrum enthusiast, James Vincent G1PVZ, who describes a UHF phase-lock loop circuit he has designed for spread-spectrum clock recovery. (Incidentally, James will receive a free one-year subscription to this Newsletter for writing his article. Submit your article, and you too will get a free one-year subscription.)

Next time, I shall describe my latest design: a simple phase-lock synthesizer operating from 1.2 to 7.5 MHz.

Before I bring this column to a close, let me quote something totally unrelated to the above, from Marcus Aurelius' Meditations (9-42): "When you are outraged by somebody's impudence, ask yourself at once, 'Can the world exist without impudent people?' It cannot; so do not ask for impossibilities. That man is simply one of the impudents whose existence is necessary to the world. Keep the same thought present whenever you come across roguery, double-dealing or any form of obliquity."

Keep on designing new circuits and programs, and send them to the AMRAD Newsletter. We can use them! Meanwhile, my best Seasons' Greetings to all of you, and happy Hamcomputing.

73 DE Andre N4ICK.



N4ICK - FIGURE

Presentations at the September 1989 AMRAD Meeting

A Synopsis

by Dick Barth, W3HWN

The September 11, 1989 meeting included a status report on the DSP board layout. The memory configuration includes three storage areas, one for program storage and two others, termed the "X" and "Y" memory in the case of Motorola chips, for data. The X area is used for storage of program coefficients and the Y for input and output data. The AMRAD board design provides 16K of program memory, and 8K each of X and Y data memory. Additional details will be provided next month.

It was noted that while the Motorola DSP chip is relatively inexpensive as these things go - seventy dollars or so - they can't be bought off the shelf at the neighborhood distributor. AMRAD's chips required three months from order to delivery, including a wait for the next production run. It would behoove those who feel like tinkering with the things to order enough the first time to meet all their anticipated needs, and maybe a spare or two, since the alternative is to put everything on hold until more chips show up.

Dave Borden (K8MMO) has been busy of late preaching the DSP gospel at neighboring radio clubs. He's spoken to the Columbia (MD) radio club, the Baltimore Amateur Radio Club and whoever else will listen. The use of DSP is expected to increase markedly in the next few years, with the first commercial amateur-oriented DSP box expected to be released late this year. This is the DSP232 by AEA, intended to be the first unit able to copy AMSAT's microsats. It uses the 56000 DSP chip as a modem and according to rumor uses Z80-like processors for other work, permitting reuse of some earlier packet code and hardware design.

One of the earliest uses of the AMRAD DSP board is expected to be in HF packet, where an improved modem design is expected to provide a drastic increase in throughput. Current designs typically use 300 baud data rates but, because of transmission errors at that speed, are forced to repeat packets so frequently that the actual throughput is comparable to 60 wpm RTTY. The design changes being considered will have to deal with Doppler and multipath common to HF transmissions. One planned approach involves changes to the transmission protocol. AX25 was designed for VHF use where paths are (comparatively) reliable and the higher permitted baud rates make longwinded packets a reasonable approach. The propagation characteristics of HF call for more efficiency.

Gene Harrison has come up with an interesting modem approach using one-of-eight tones, and this is under consideration.

It is also possible to play with DSP using simple A/D and D/A converters, while doing the processing in an existing computer such as a PC clone. Andre Kesteloot N4ICK spoke to this approach, which allows DSP experimentation without the need to spend five or six hundred dollars on a full-blown DSP board. The board used here plugs into the PC bus and uses the MAX164 (see below). It has an analog amplifier in addition to the A/D and requires a 1.5 MHz crystal (or equivalent clock intput) for operation.

Bare boards of this type are available from various sources. The one first used by Andre cost $29 from JDL Microdevices but appeared to have some quality control problems, and it was decided to use a board from another source for future experiments.

Andre demonstrated this board running in a generic XT clone, where the output of an audio oscillator was sampled at 41 KHz. The chip will sample at 100 KHz if driven by a fast enough computer. The reconstituted output of the D/A contained a certain amount of noise coming from the computer's power supply; the manufacturer claims that with a good power supply a 74 dB SNR can be obtained at the output.

The interrupt structure of the XT clone limits accuracy of this sort of approach to .01 seconds if processing is done in real time. This can be a problem in obtaining accurate results. Andre has been thinking of using an alternate approach in which a 32 KHz watch crystal can be used to drive the conversion process with the data processed in non-real time.

Lawrence Kesteloot N4NTL next presented a demonstration of the system and the explanation of the software he had prepared for it.

Data sheets were circulated for some of Maxim's CMOS sampling 12- bit A/D conversion chips with track and hold. They are the MAX163, MAX164 and MAX167. Conversion time is 8.33 microseconds. These chips are compatible with many popular microprocessors and will be available from local distributors for $21 in small quantities; prices at the unit level aren't known here. Schematics for the board will appear in the AMRAD newsletter and software will be made available for downloading from the AMRAD BBS.

Presentations at the October 1989 AMRAD Meeting

A Synopsis

by Dick Barth, W3HWN

The October 2, 1989 AMRAD meeting featured a discussion of the DSP board designed by Terry Fox, WB4JFI. Dave Borden, K8MMO, kicked off the evening with a discussion of how the hardware was produced. Maitland Bottoms AA4HS then covered the software and Terry Fox discussed the hardware design.

Terry had provided Autocad schematics of the board, starting with the memory subsystem which includes 12 each 8Kx8 bit memory chips. The board uses 24 bit data, so there are 3 chips per bank. There are 16K of program memory, and 8K each of X and Y memory. The 45 nanosecond memory costs from fourteen to eighteen dollars per chip. John Teller (N4NUN) actually built the thing using Terry's design.

The DSP CPU subsystem came next. It's a fairly simple circuit using a Motorola 56000 chip ($70) and socket ($5); a 2716 EPROM; TTL/RS-232 conversion circuitry (148x or equal); and assorted small parts. When the board is first reset the circuit inserts fifteen wait states into the system so it can read the 2716, which is unreadable when the thing is running full bore at 10 MIPS.

The CPU reads the 2716 at $C000 and copies it into fast RAM at $0180 for future reference. It contains a boot loader from Motorola and a Kermit-like terminal program written by John.

The A/D and D/A conversion circuitry forms another subsystem which needs to be added to the board. Motorola has a chip called the DSP5680C16, a 16-bit A/D converter which interfaces with the DSP chip on three wires. A 12 MHz crystal oscillator is also needed.

A cross-assembler for the DSP chip is available to run on MS-DOS machinery. Code for the 56000 is thus written and assembled on a PC clone, with the load file then downloaded to the DSP board using Kermit which John's terminal can deal with. The software for the DSP chip is the creation of Maitland Bottoms.

The boot EPROM in the DSP machine serves the same function as a boot ROM in a PC: it has the machine look elsewhere for software that will allow it to do something useful. While a PC looks for a disk, the DSP chip looks for a load file. This is a file similar to the S1/S9 files familiar to 6800 programmers in that it contains executable code and load addresses in the form of hexadecimal ASCII.

The 56000 has on-chip peripherals including a buffered asynchronous serial port and software control of the number of wait states. When the system is reset, the loader begins to execute and examines the serial port to see whether a load file is coming down the pipe. In our case, what is seen at the serial port is a PC clone, sending 8K worth of a monitor program called DSPBUG (which again should sound familiar to old 6800 hackers). This provides the ability to examine and change registers and do the other things one expects of a debugging monitor. DSPBUG is stored from $0200 to $1686. Finally, the loader jumps to the execution address of DSPBUG. You can run a command called LOD which allows you to load in Maitland's A/D program or whatever you want to run.

The decision was made in the hardware design stage to include two banks of program memory. One bank can be used for the installation of an executable library in EPROM, for example. The other bank will include RAM and be used for downloading of software from the DSP host (clone equivalent). A Motorola DSP chip can be brought up by copying EPROM contents into RAM as is done on the AMRAD machine. Or, the chip can run directly from the EPROM. Or it can load its operating software from the host. It is planned to have the serial port in the PC use DMA, so that the PC and the DSP machine can pass data at DMA speeds.

The potential uses of these DSP boards appears limitless. It should allow legal 9600 baud data transmissions on two meters, using the DSP board as a modem into a standard two-meter rig. It should be able to subtract out background noise from speech recorded in a noisy environment, provided the noise is fairly regular. The process becomes more difficult if it includes random percussive noises (things dropping, etc.)

Terry reported seeing, at the recent convention of the National Association of Broadcasters, a complete audio mixing console that used no tape at all; mixing was done in RAM. Also, the previous version is saved for reuse in case of operator error. Storage time was limited by the amount of RAM but was adequate for preparation of a brief commercial or other announcement.

Electronic Equipment

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Scott Schaefer WR4S
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Customer Engineering
Manager

BUSINESSLAND

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3846 S. Four Mile Drive
Arlington, VA 22206
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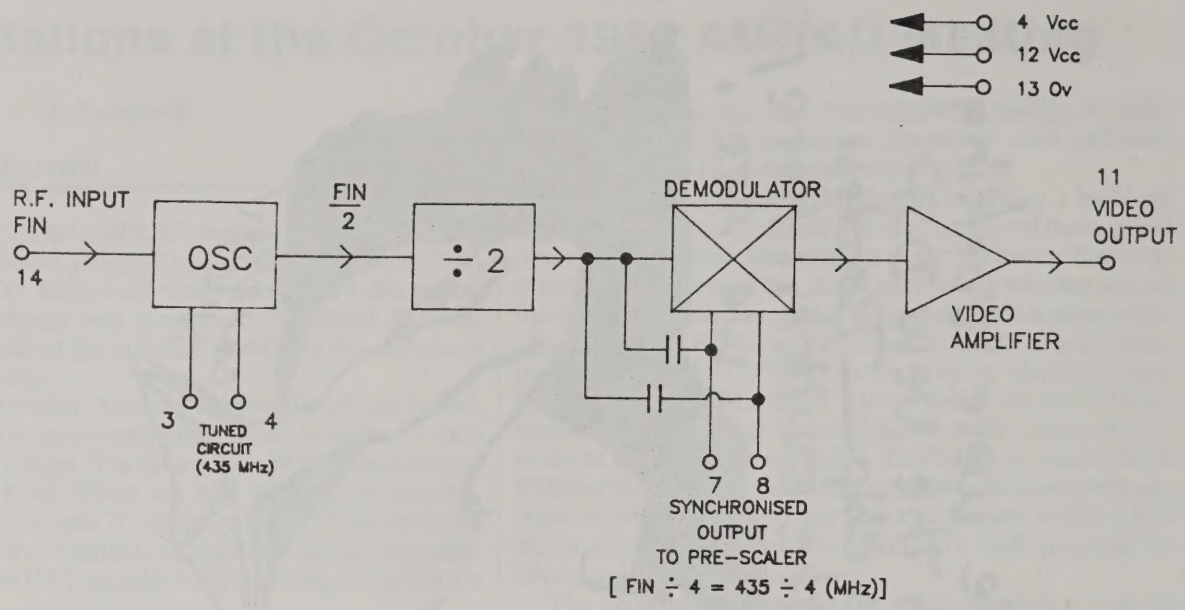
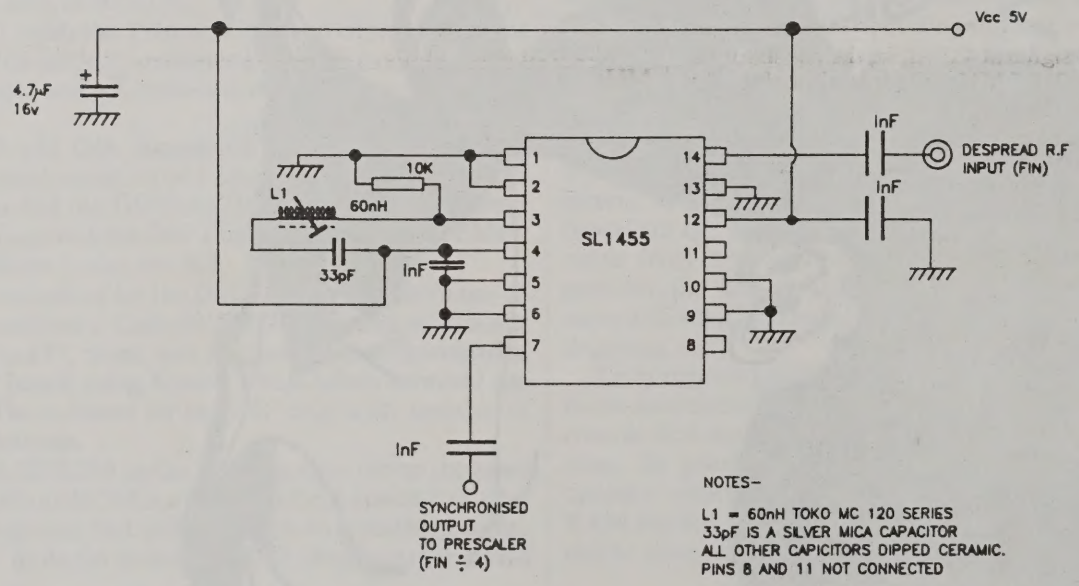
YUP! We were working
With the New DSP
68000 chip — Borden
Flipped the switch.. Here!
we Are!
Chuck
N4EZV



BLOCK DIAGRAM OF SL 1455 BASED SYNCHRONOUS OSCILLATOR



CIRCUIT DIAGRAM 435 MHz SYNCHRONOUS OSCILLATOR

© JAMES VINCENT G1PVZ JUNE 1989

G1PVZ - FIGURE

INJECTION-LOCKED SYNCHRONOUS OSCILLATOR IN A SINGLE I.C. PACKAGE

by James Vincent G1PVZ.

For some time I have been experimenting with a Direct Sequence Frequency Modulated (DSFM) modulator and demodulator system similar to Andr Kesteloot's system described in QST May 1989. I had a pre-publication copy of Andr's article, and for some time had been trying to produce a 435 MHz Synchronous Oscillator based on the original Uzunoglu and White IEEE article. I had little success and therefore decided to look at alternative circuits.

Plessey Semiconductors manufacture a wide range of communication and satellite-television integrated circuits. One such device is the SL1455 Wideband FM demodulator with Threshold Extension which is designed to demodulate the FM video signal in Direct Broadcast Satellite (DBS) receivers with an intermediate frequency of between 300 MHz and 600 MHz. It consists of four major sections, an injection locked oscillator operating at one half the RF input frequency to which the system should lock, a divide-by-two stage, a quadrature demodulator/amplifier stage and a video amplifier stage. If the oscillator is dimensioned to operate at 435/2 MHz then the F osc/2 (435 MHz / 4) signal can be tapped at pin 7 of the device (there are coupling capacitors within the I.C. structure between the divide-by-two stage and the quadrature network pins).

To enable the circuit to frequency-lock to the de-spread Direct Sequence carrier signal at 435 MHz, the oscillator oscillates at approximately 216.5 MHz. On injection of the de-spread signal, the oscillator locks to the input carrier and tracks it. With no input signal the oscillator idles at around 216 MHz with a corresponding 108.745 MHz (435 MHz / 4) output at pin 7 of the device. By adjusting the coil, the oscillator is made to oscillate at a frequency marginally greater than 216.5 MHz so that it can act as a frequency source for the sliding correlator in the Direct Sequence demodulator. The output from pin 7 is capacitively coupled to a pre-scaler device which divides by 64 to produce the clock for the pseudo-random code generator at the receiver de-spreader.

The circuit was simple to build and easy to adjust, the frequency is monitored at pin 7 with a frequency counter and the coil slug adjusted until the desired frequency is input within the lock range whereupon the oscillator will lock and track the injected signal. The stability of the oscillator is dependent on the power supply to the I.C. and thus the power supply should be stabilized.

In initial tests the circuit has locked to an input signal over a wide amplitude range and has operated in a direct sequence modulator/demodulator system very effectively. Further tests need to be performed to fully characterize the circuit, but it appears to be an effective and simple approach to a synchronous oscillator implementation.

Preliminary Test Results

Power Supply 5.00 Vdc at 34mA

Idle frequency output (no carrier injected) = 3.407279 MHz

AMRAD MEMBERSHIP APPLICATION/RENEWAL

Mail to: Membership, AMRAD, P.O. BOX 6148, McLean, Va. 22106-6148

ANNUAL DUES: Regular $15; 2nd in family at same address add $8; Canada and Mexico add $2; foreign surface add $2.30; foreign air mail add $8; currency is US dollars. A donation to the WD4IWG/R repeater fund is appreciated if you use the repeater. Please make checks payable to AMRAD.

Name_____ Amateur Call_____License Class_____

Street Address_____

City_____State/Prov_____ZIP/PC_____

Country_____ Home Phone (___)____-_____ Work Phone (___)____-_____

Special Interest Groups: please indicate your interest.

__Deaf Comm __RTTY __Spread Spectrum __Packet Radio __Digital Signal Processing

Network: CompuServe ID:_____

_____ ID:_____

Packet Radio mail box _____ ARRL member?____

AMRAD

The Amateur Radio Research and Development Corporation (AMRAD) is a worldwide club of several hundred amateur radio and computer experimenters. It is incorporated in Virginia and is recognized by the U.S. Internal Revenue Service as a tax-exempt scientific and educational organization.

AMRAD's Purpose

The purpose of AMRAD is to: develop skills and knowledge in radio and electronic technology; advocate design of experimental equipment and techniques; promote basic and applied research; organize technical forums and symposiums; collect and disseminate technical information; and provide experimental repeaters.

Meetings

Meetings are on the first Monday of each month at 7:30 P.M. at the Red Cross Building, Merrifield, VA. If the first Monday is a holiday, an alternate date will be announced in the newsletter. Except for the annual meeting in December, meetings are reserved for technical talks - not business.

WD4IWG Repeater

WD4IWG/R is an open repeater for FM voice and digital communications, especially for experimental modes. It is located in McLean, VA. It features an autopatch available to licensed members. Frequencies are: 147.81 MHz in and 147.21 MHz out. The repeater director is Jeff Brennan, WB4WLW.

Westlink Report

The Westlink report is aired every Sunday night at 8:00PM on the WD4IWG repeater.

WB4JFI-5 Digipeater

WB4JFI-5 is a 1200-baud AX.25 Level 2 digipeater operating on 145.01 MHz. It is located in northwest Washington DC at Wisconsin Ave. and River Rd. The digipeater is mounted at an elevation of 350 feet on the south leg of the WUSA/WJLA TV tower.

Data Address

Our CompuServe/Micronet number is [72345,1050].

AMRAD Computer Bulletin Board System

AMRAD CBBS, (703) 734-1387, is operated by Lawrence Kesteloot, N4NTL. The system accepts calls at 300, 1200 and 2400 baud. The data path settings are 8 data bits, 1 stop bits, and no parity.

HEX Bulletin Board System

Handicapped Education Exchange is operated by Dick Barth, W3HWN. HEX accepts TDD/300 baud at (301) 593-7033,and 300/1200 baud at (301) 593-7357. ASCII is 8N1

Affiliations

AMRAD is affiliated with the American Radio Relay League (ARRL), Foundation for Amateur Radio (FAR), Northern Virginia Radio Council (NOVARC) and the Mid-Atlantic Repeater Council (T-MARC).

AMRAD Newsletter

The AMRAD newsletter is mailed six times a year to members and other clubs on an exchange basis. Technical articles, product announcements, news items, and other copy relating to amateur radio and computing is welcome. Honorariums of one year free membership are given for original material accepted. Maximum of one year per year. Classified ads are free to members. Commercial ad inquires are invited. The editor reserves the right to reject or edit any portions of the copy. Items should be mailed to Editor, AMRAD Newsletter, P.O. Drawer 6148, McLean, VA 22106. Full permission for reprinting or quoting items is granted provided that credit is given to both the author and the newsletter. Membership in AMRAD is $15 annually ($8 for second member of same family). Mailing to U.S. and possessions is by 3rd Class bulk mail. Canadian and Mexican addresses add $2 for postage. Overseas readers add $8 for air mail or $2.30 for surface.

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